evaluation of SMPC components, such as SMPC hinge and boom. Different types of components have been developed to better meet the need of space deployable structures, such as solar arrays and deployable panels, reflector antennas.

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Colonization of the Moon. Myth or Reality?

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1. Introduction

"That's one small step for (a) man, one giant leap for mankind." – Famous words said when Armstrong first stepped onto the moon (20 July 1969). Interestingly enough, no human being has stepped foot on the Moon since 1972. It has been 39 years since we've last treaded the mysterious dusty surface – but to this day groundbreaking discoveries are made year after year [1].

The colonization of the Moon is the proposed establishment of permanent human communities on the Moon. This paper evaluates the extent feasible the idea of colonization the moon and its economic feasibility [2].

The notion of setting a colony on the Moon originated before the Space Age. In 1638 Bishop John Wilkins wrote A Discourse Concerning a New World and Another Planet, in which he predicted a human colony on the Moon. Konstantin Tsiolkovsky, among others, also suggested such a step. From the 1950s onwards, a number of concepts and designs have been suggested by scientists, engineers and others [3].

2. Myth or reality?

Permanent human habitation on a planetary body other than the Earth is one of science fiction's most prevalent themes [4]. As technology has advanced, and concerns about the future of humanity on Earth have increased, the argument that space colonization is an achievable and worthwhile goal has gained momentum. Because of its proximity to Earth, the Moon has been seen as the most obvious natural expansion after Earth.

3. Advantages and disadvantages

Putting aside the general questions of whether a human colony beyond the Earth is feasible or scientifically desirable in light of cost-efficiency, proponents of space colonization point out that the Moon offers both advantages and disadvantages as a site for such a colony [2]. Naturally there are pro's and con's to colonization.

3.1 Advantages

Placing a colony on a lunar body would provide an ample source of material for construction and other uses, including shielding from radiation and a source of land for nations. The energy required to send objects from the Moon to space is much less than from Earth to space. This could allow the Moon to serve as a construction site or fueling station for spacecraft. Some proposals include using electric acceleration devices to propel objects off the Moon without building rockets. Others have proposed momentum exchange tethers. Furthermore, the Moon does have some gravity, which, experience to date indicates, may be vital for fetal development and long-term human health. Whether the Moon's gravity is adequate for this purpose, however, is uncertain.

The energy required to send objects from Earth to the Moon is lower than for most other bodies.

The short transit time would allow emergency supplies to quickly reach a Moon colony from Earth, or allow a human crew to evacuate relatively quickly from the Moon to Earth in case of emergency.

The round trip communication delay to Earth is less than three seconds, allowing near-normal voice and video conversation. The delay for other solar system bodies is minutes or hours; for example, round trip communication time between Earth and Mars ranges from about eight minutes to about forty minutes.

Being so close to Earth would mean near immediate communication between both bodies. With the Moon being so close, any failures or emergencies would be able to be attended too quickly. Colonizing the Moon would help test if human’s can survive in a low-gravity atmosphere.

3.2 Disadvantages

The long lunar night would impede reliance on solar power and require a colony to be designed that could withstand large temperature extremes. An exception to this restriction are the so-called "peaks of eternal light" located at the lunar north pole that are constantly bathed in sunlight. The rim of Shackleton Crater, towards the lunar South Pole, also, has a near-constant solar illumination. Other areas near the poles that get light most of the time could be linked in a power grid.

The Moon lacks light elements, such as carbon and nitrogen, although there is some evidence of water and cheese Insert non-formatted text here. Insert non-formatted text here at the lunar poles. Additionally, oxygen, though one of the most common elements in the regolith constituting the Moon's surface, is only found bound up in minerals that would require complex industrial infrastructure using very high energy to isolate. Some or all of these volatiles are needed to generate breathable air, water, food, and rocket fuel, all of which would need to be imported from Earth until other cheaper sources are developed. This would limit the colony's rate of growth and keep it dependent on Earth. The cost of volatiles could be reduced by constructing the upper stage of supply ships using materials high in volatiles, such as carbon fiber and other plastics, although converting these into forms useful for life would involve substantial difficulty.

There is continuing uncertainty over whether the low (one-sixth g) gravity on the Moon is strong enough to prevent detrimental effects to human health in the long term. Exposure to weightlessness over month-long periods has been demonstrated to cause deterioration of physiological systems, such as loss of bone and muscle mass and a depressed immune system. Similar effects could occur in a low-gravity environment, although virtually all research into the health effects of low gravity has been limited to zero gravity. Countermeasures such as an aggressive routine of daily exercise have proven at least partially effective in preventing the deleterious effects of low gravity. But muscle mass and bone calcium would certainly not deteriorate below the minimum for functioning in lunar gravity. It is arguable that the gravity issue is no more a problem than the fact that light-skinned Humans would have difficulties "returning" to Humanitys ancestral home Africa due to ultraviolet radiation. After all, why should Earth have such a central position in a cosmic human culture, except from the fact that Humans originally evolved there?

Some of the con's would be not fully knowing or understanding the long term effects of the low gravity on a human being. Serious irreversible illness could afflict us. A lack of atmosphere would make the colonies very susceptible to being bombarded by meteors. And most importantly – moon dust. It's highly abrasive and glassy. It sticks to almost everything, like equipment and instruments, even, and is possibly toxic.

The lack of a substantial atmosphere for insulation results in temperature extremes and makes the Moon's surface conditions somewhat like a deep space vacuum. It also leaves the lunar surface exposed to half as much radiation as in interplanetary space. Although lunar materials would potentially be useful as a simple radiation shield for living quarters, shielding against solar flares during expeditions outside is more problematic. Radiation meteorology would be useful. There is also research on drugs that can repair damage caused by radiation, though they are intended to repair damage caused by chronic cosmic radiation and may be inadequate for flares [2].

4. Launch costs

Estimates of the cost per pound of launching cargo or people from the Moon vary and the cost impacts of future technological improvements are difficult to predict. An upper bound on the cost of launching material from the Moon might be about $40,000,000 per kilogram, based on dividing the Apollo program costs by the amount of material returned. At the other extreme, the incremental cost of launching material from the Moon using an electromagnetic accelerator could be quite low. The efficiency of launching material from the Moon with a proposed electric accelerator is suggested to be about 50%. If the carriage of a mass driver weighs the same as the cargo, two kilograms must be accelerated to orbital velocity for each kilogram put into orbit. The overall system efficiency would then drop to 25%. So 1.4 kilowatt-hours would be needed to launch an incremental kilogram of cargo to low orbit from the Moon. At $0.1/kilowatt-hour, a typical cost for electrical power on Earth, that amounts to $0.16 for the energy to launch a kilogram of cargo into orbit. For the actual cost of an operating system, energy loss for power conditioning, the cost of radiating waste heat, the cost of maintaining all systems, and the interest cost of the capital investment are considerations [5].

Pro's and con's aside there is little reason not to start exploring other bodies for human colonization. Earth will eventually run out of resources. We as a species need to adapt or die [1].

5. Conclusion

The Moon is a very interesting destination in its own right. Being closer to the Earth creates engineering, economic, and political opportunities. The Moon may make a Mars colony feasible or desirable, thus enabling three branches of humanity. A lunar colony can use much more mass imported from Earth and more flexible and capable engineering. Tourism may independently justify lunar colonization, but science, technology, skills and entertainment make the case stronger. Having a new place to live with new laws, customs, and ideas may ultimately be the most valuable contribution of all.

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